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In the Claims

1.   (Original) A dynamic cardiac phantom comprising:

a hollow chamber made of pliable material to expand and contract based on an injection and discharge of fluid therein; and

at least one inlet connected to the hollow chamber at one end and having another end connectable to a fluid source to inject and discharge fluid into the hollow chamber in a manner to simulate cardiac motion.

2.   (Original) The dynamic cardiac phantom of claim 1 wherein the hollow chamber has a shape to simulate that of a heart.

3.   (Original) The dynamic cardiac phantom of claim 2 wherein the hollow chamber has a plurality of protrusions extending therefrom, the plurality of protrusions having a shape to simulate a plurality of chambers of the heart.

4.   (Original) The dynamic cardiac phantom of claim 1 wherein the fluid includes water.

5.   (Original) The dynamic cardiac phantom of claim 1 wherein the at least one inlet is further configured to inject and discharge fluid into the hollow chamber in a plurality of modes, the plurality of modes including a slow drain, a rapid drain, a change-over to supply, a rapid supply, a slow supply, and a change-over to drain.

6.   (Original) The dynamic cardiac phantom of claim 5 wherein the slow drain mode is 100 per 1,000 ms., the rapid drain mode is 150 ms. per 1,000 ms., the change-over to supply mode is 50 ms. per 1,000 ms., the rapid supply mode is 100 ms. per 1,000 ms., the slow supply mode is 500 ms. per 1,000 ms., and the change-over to drain mode is 100 ms. per 1,000 ms.

7.   (Original) A cardiac motion simulator for use with an imaging system, the simulator comprising:

a balloon having an inlet and a plurality of outlets, the inlet configured to at least receive fluid; and

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a plurality of tubes corresponding in number to the plurality of outlets, each tube having an inlet connected to an outlet of the balloon, wherein the plurality of tubes is configured to receive fluid exiting the plurality of balloon outlets;

wherein the balloon expands upon receipt of fluid and retracts upon discharge of fluid to mimic cardiac motion.

8.   (Original) The cardiac motion simulator of claim 7 further comprising a pump connected to the balloon inlet and configured to supply fluid and drain fluid from the balloon and plurality of tubes.

9.   (Original)   The cardiac motion simulator of claim 8 wherein the pump is configured to operate in a plurality of modes that includes a cyclically slow drain, a rapid drain, change-over to supply, a rapid supply, a slow supply, and a change-over to drain the balloon and the plurality of tubes in mimicking cardiac motion.

10.   (Original) The cardiac motion simulator of claim 9 wherein the pump is further configured to slowly drain the balloon and the plurality of tubes for 100 ms. per 1,000 ms., rapidly drain the balloon and the plurality of tubes for 150 ms., per 1,000 ms., change-over to supplying for 50 ms. per 1,000 ms., rapidly supply fluid to the balloon and the plurality of tubes for 100 ms. per 1,000 ms., slowly provide fluid to the balloon and the plurality of tubes for 500 ms. per 1,000 ms., and change-over to draining for 100 ms. per 1,000 ms.

11.   (Original) The cardiac motion simulator of claim 10 wherein the pump is further configured to vary the supplying, change-over, and draining for each cycle.

12.   (Original) The cardiac motion simulator of claim 8 further comprising a supply pipe configured to transport fluid between the balloon inlet and the pump.

13.   (Original) The cardiac motion simulator of claim 8 wherein the fluid is water and further comprises a control configured to regulate the supplying and draining of fluid by the pump.

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14.   (Original)   The cardiac motion simulator of claim 13 wherein the control is further configured to regulate the supplying and draining of fluid by the pump using EKG traces of a patient.

15.   (Original)   The cardiac motion simulator of claim 14 wherein the control has a programmable storage medium and is configured to modulate the pump using stored EKG data.

16.   (Original)   A computer readable storage medium having thereon a computer program representing a set of instructions that when executed by a computer causes the computer to:

    (A)   supply fluid to an expandable chamber having a number of expandable tubes connected thereto;

        (B)   slowly empty fluid from the expandable chamber;

        (C)   rapidly empty fluid from the expandable chamber;

        (D)   rapidly supply fluid to the expandable chamber; and

        (E)   slowing supply fluid to the expandable chamber.

17.   (Original)   The computer readable storage medium of claim 16 wherein the set of instructions further causes the computer to cyclically repeat any act (B) through (E) so as to simulate heart motion in a patient.

18.   (Original)   The computer readable storage medium of claim 17 wherein the set of instructions further causes the computer to empty fluid in acts (B) and (C) and supply fluid in acts (D) and (E) based on EKG traces from a patient.

19.   (Original)   The computer readable storage medium of claim 17 wherein the set of instructions further causes the computer to determine a total cycle time period and a time period for each of:

        slowly emptying fluid;
        rapidly emptying fluid;
        rapidly supplying fluid; and
        slowly supplying fluid.

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20.   (Original) The computer program of claim 19 wherein the time period for slowly emptying fluid is 10% of the total cycle time period, the time period for rapidly emptying fluid is 15% of the total cycle time period, the time period for rapidly supplying fluid is 10% of the total cycle time period, and the time period for slowly supplying fluid is 50% of the total cycle time period.

21.   (Original) The computer readable storage medium of claim 19 wherein the set of instructions further causes the computer to determine a change-over time period between the rapidly emptying fluid time period and the rapidly supplying fluid time period and another change-over time period between the slowly supplying fluid time period and the slowly emptying fluid time period.

22.   (Original) The computer readable storage medium of claim 21 wherein the change-over time period is 5% of the total cycle time period and the another change-over time period is 10% of the total cycle time period.

23.   (Original) The computer readable storage medium of claim 22 wherein the set of instructions further causes the computer to vary each time period with each repetition of acts (B) through (E).

24.   (Original) The computer readable storage medium of claim 23 wherein the set of instructions further causes the computer to vary each time period with each repetition of acts (B) through (E) by 20%.

25.   (Original) A method of phantomming cardiac motion for use with a scanner, the method comprising:

connecting a balloon having an inlet and a number of tubular protrusions to a fluid reservoir;

filling the balloon with fluid;

circulating fluid to and from the balloon; and

acquiring imaging data of the balloon during the circulation step.

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26.   (Original) The method of claim 25 further comprising generating a reconstructed image from the acquired imaging data and determining artifact presence in the reconstructed image.

27.   (Original) The method of claim 26 further comprising repeating the circulating, acquiring, and generating steps using at least one of a new acquisition protocol and a new image reconstruction protocol designed to reconstruct an image with reduced artifacts.

28.   (Original) The method of claim 25 further comprising circulating the fluid in accordance with a number of defined phases.

29.   (Original)   The method of claim 28 wherein the number of defined phases include:

    a slow empty phase;
    a rapid empty phase;
    change-over to filling phase;
    rapid filling phase;
    slow filling phase; and
    charge over to empty phase.

30.   (Original) The method of claim 29 further comprising defining the number of defined phases using analyzed data from an EKG of a patient.

31.   (Original) The method of claim 25 wherein the circulating further comprises:
    slowly emptying fluid from the expandable chamber for 100 ms. per 1,000 ms.;
    rapidly emptying fluid from the expandable chamber for 50 ms. per 1,000 ms.;
    pausing for 50 ms per 1,000 ms.;
    rapidly filling the expandable chamber for 100 ms. per 1,000 ms.;
    slowly filling the expandable chamber for 500 ms. per 1,000 ms.; and
    pausing again for 100 ms. per 1,000 ms.

32.   (Original) The method of claim 25 further comprising programming a computer to regulate the circulating of fluid to and from the balloon.

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33.   (Original) The method of claim 25 wherein the scanner includes at least one of a CT scanner, an NM/PET scanner, an MRI scanner, and an x-ray scanner.

34.   (Original) A computed tomography system comprising:

a rotatable gantry having an opening;

a high frequency electromagnetic energy projection source to project high frequency energy toward an object;

a scintillator array having a plurality of scintillators to receive high frequency electromagnetic energy attenuated by the object;

a photodiode array having a plurality of photodiodes, wherein the photodiode array is optically coupled to the scintillator array and is configured to detect light energy emitted therefrom;

a plurality of electrical interconnects configured to transmit photodiode outputs to a data processing system;

a computer to produce a visual display based upon the photodiode outputs transmitted to the data processing system; and

wherein the object includes an expandable balloon having a number of tubular protrusions and an inlet configured to receive circulating fluid such that circulation of the fluid simulates cardiac motion.

35.   (Original) The computed tomography system of claim 34 further comprising a pump and a fluid reservoir, the pump configured to cyclically provide and drain fluid from the balloon.

36.   (Original) The computed tomography system of claim 34 further comprising a programmable control configured to modulate the pump to provide cardiac motion simulation.

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